BIRD SURVEYS AT MCKINLEY AND HUTCHISON BAY, NORTHWEST TERRITORIES, IN 1990.

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ABSTRACT

Monitoring surveys of bird abundance and distribution were conducted in 1990 at McKinley Bay, NWT, the site of a winter harbour for drillships and proposed location for a major year-round support base for oil and gas exploration. The 1990 surveys represented a continuation of a long-term monitoring study of birds in McKinley Bay and Hutchison Bay, a nearby area used as a control. Primary objectives of the 1990 surveys were to determine whether diving duck numbers had changed since the initial phase of the study from 1981 to 1985, and to provide additional baseline data on natural annual fluctuations in diving duck numbers.

Three aerial surveys at each bay were carried out between August 1 and August 5, 1990, using techniques identical to previous years. On August 5, 1990, when survey conditions were considered best of the three surveys, more than twice as many diving ducks were found in McKinley Bay and Hutchison Bay than on average during the five years from 1981 to 1985. An estimated 27,900 ±4006 divers utilized McKinley Bay on August 5, 1990, and 28,591 ±3471 were estimated in Hutchison Bay.

As in previous years of the study, Oldsquaw and scoters comprised about 90% of the diving ducks observed at both bays. Both species showed significant increases in numbers in the 1990 study compared to 1981 to 1985 ($p < 0.05$). Other divers seen were scaup, Red-breasted Mergansers, and King Eiders.

Patterns of distribution of diving ducks within McKinley Bay in 1990 were similar to patterns observed in previous years. Scoters tended to concentrate at the south end of the bay. Oldsquaw were more scattered, but occurred most commonly in three areas: south of the artificial island, south of Atkinson Point spit and at the south end of the bay. Consistent patterns of distribution were not as clear at Hutchison Bay.

Northern Pintails were the most common birds recorded in the terrestrial areas at both bays in 1990. At McKinley Bay, Northern Pintails were more abundant in 1990 than in previous years, whereas at Hutchison Bay they were similar in numbers to earlier years of the study. Lagoons, ponds and littoral flats were favoured areas for dabbling ducks, geese and swans. Two specific areas important for geese at McKinley Bay were the littoral flats east of Louth Bay and the long narrow lagoon entering the south end of the bay.

RÉSUMÉ

Des relevés surveillance du nombre d'oiseaux et de leur répartition ont été menés en 1990 à la baie McKinley (T.N.-O). Il s'agit d'un port d'hivernage pour les navires de forage pétrolier, et on propose d'en faire une importante base de soutien, ouverte à l'année, pour l'exploration du pétrole et du gaz. Les relevés de 1990 faisait partie d'une surveillance à long terme des oiseaux à la baie McKinley et à la baie Hutchison, une région avoisinante utilisée comme repère. L'objectif principal en 1990 était de déterminer si le nombre de canards plongeurs avait changé depuis la phase initiale de l'étude (1981 à 1985), et d'offrir des données de base supplémentaires sur les variations annuelles naturelles du nombre de canards plongeurs.

Trois relevés aériens ont été mené à chacune des baies entre le 1er et le 5 août 1990, selon les mêmes techniques que les années précédentes. Le 5 août 1990, jour où les conditions ont été les meilleures pendant les relevés, on a recensé, dans la baie McKinley et dans la baie Hutchison, deux fois et plus de canards plongeurs qu'il y en avait en moyenne de 1981 à 1985. Ce jour-là, environ 27 900 (plus ou moins 4 000) canards plongeurs se trouvaient à la baie McKinley, et 28 591 (plus ou moins 3 471) à la baie Hutchison.

Comme au cours des années précédentes, le Canard kakawi et la macreuse représentaient environ 90 % des canards plongeurs aux deux baies. On a observé une augmentation importante du nombre de ces deux espèces en 1990, comparée à l'étude menée de 1981 ($p<0.05$). Les autres espèces de canards plongeurs observés étaient le morillon, le Bec-scie à poitrine rousse et l'Eider à tête grise.

En 1990, la répartition des canards plongeurs dans la baie McKinley était semblable à la répartition observée au cours des années précédentes. Les macreuses avaient tendance à se regrouper à la limite sud de la baie. Les Canards kakawis étaient plus dispersée, mais on les retrouvait surtout dans trois régions : au sud de l'île artificielle, au sud de la flèche de la pointe Atkinson et à la limite sud de la baie. La répartition n'était pas aussi clairement définie à la baie Hutchison.

En 1990, l'oiseau le plus souvent observé dans les zones terrestres des deux baies était le Canard pilet. À la baie McKinley, les Canards pilets étaient plus nombreux en 1990 qu'au cours des années précédentes, alors qu'à la baie Hutchison, leur nombre était similaire à celui des premières années de l'étude. Les canards de surface, les oies et bernaches et les cygnes favorisaient surtout les lagunes, les étangs et les plaines du littoral. Deux des endroits de prédilection des oies et bernaches à la baie McKinley étaient les plaines littorales situées à l'est de la baie Louth et la longue lagune étroite pénétrant la limite sud de la baie.

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1.0 INTRODUCTION

McKinley Bay, a shallow protected bay on the north side of the Tuktoyaktuk Peninsula, Northwest Territories (NWT), has been used as a winter harbour and support base for oil and gas exploration in the Beaufort Sea since 1979. A brief history of the industrial development in the bay, as well as a summary of recent industrial activity, is given in Appendix A. Major activity directed towards continuing the development of the bay has not occurred since 1981. However, in the future, this bay may become a major year-round support base for Beaufort Sea oil and gas drilling activity.

The Canadian Wildlife Service initiated a study in 1981 to monitor the effects of industrial development and activity on bird populations using the bay. The objective of the study was to collect baseline information on natural annual fluctuations in numbers of birds, for use in detecting potential changes in bird usage of the bay due to harbour development. Hutchison Bay, an undeveloped bay of similar size about 45 km to the west, was also surveyed as a control. Emphasis throughout the study has been placed on documenting the fluctuations in numbers and distribution of diving ducks, due to their vulnerability to oil spills. Results of the 5-year initial phase of the study were presented in an earlier report (Cornish and Dickson 1986).

Annual aerial surveys from 1981 to 1985 determined that large numbers of diving ducks, primarily Oldsquaw and scoters, use both bays each year for moulting (Cornish and Dickson 1986). On the average during the five years of the study, over 12 000 diving ducks occurred in McKinley Bay in early August each year, while an average of over 13 000 ducks utilized Hutchison Bay. During this period, numbers of scoters and Oldsquaw using McKinley Bay varied significantly in some years, although numbers of Oldsquaw were less variable than scoters (Cornish and Dickson 1986).

In order to determine whether diving duck numbers had changed significantly in the five years since completion of the initial phase of the study, aerial surveys were again conducted in 1990 at McKinley Bay and Hutchison Bay. The 1990 data also expands the set of baseline data on natural fluctuations in numbers of diving ducks and other birds. This report summarizes the findings of surveys conducted in 1990.

2.0 METHODS

2.1 Aerial Surveys

To allow comparisons between sets of data on abundance and distribution of birds, the same survey methods were used during the 1990 surveys as during the initial phase of the study, from 1981 through 1985. East-west transects were flown 2 km apart (Figs. 1 and 2), in a Cessna 185 at an elevation of 30 m above ground level and at an average speed of 145 km/h. One observer on each side of the aircraft counted all birds seen within 180 m of that side, so that the total transect width was 360 m. Observations were dictated into tape recorders so that observers never had to look away from the transect. Counting bias due to differences in observer skill was reduced since observers during the 1990 surveys were the same individuals as throughout the initial phase of the study (with the exception of one of the observers in 1981.)

It became apparent from surveys conducted in the early years of the study that the peak period of moult for diving ducks in the bay was the first two weeks of August (Cornish and Allen 1983), and that good survey conditions (calm sea and light cloud) were imperative for accurate survey results. Accordingly, in 1990 each bay was surveyed three times in early August, on days when survey conditions were expected to be suitable: on August 1, 4 and 5 at McKinley Bay and on August 1, 2 and 5 at Hutchison Bay. The data from the day with the best survey conditions were then used for comparison to other years.

The study area at McKinley Bay was divided into three components: the area inside McKinley Bay called the bay component, a terrestrial component, and a section of marine habitat outside McKinley Bay called the outside component (Fig. 1). The bay component encompassed saltwater areas within McKinley Bay, including exposed sandspits which were intermittently washed over by tides. Protected shallow lagoon areas, including the small branching lagoon system east of Louth Bay and the long narrow lagoon extending about 7 km south of McKinley Bay, were considered terrestrial, as were all inland lakes. The area west of Atkinson Point,the small bay at the west end of transects 4 to 6, and the western half of transect 1 were considered the outside component. The areas of each component and the proportions surveyed are listed in Table 1. The total size of the study area was 306 sq. km. The area of the bay component of the McKinley Bay study area was 108.5 sq. km. and the terrestrial component was 158.5 sq. km.

At Hutchison Bay, the study area was also divided into three components (Fig. 2). Again, open exposed marine areas within the bay, and sandspits intermittently washed over by tides were considered bay component. The isolated lagoon at the east end of transect 4, the narrow, shallow channels of the bay along transects 6 and 7, and all inland lakes were included in the

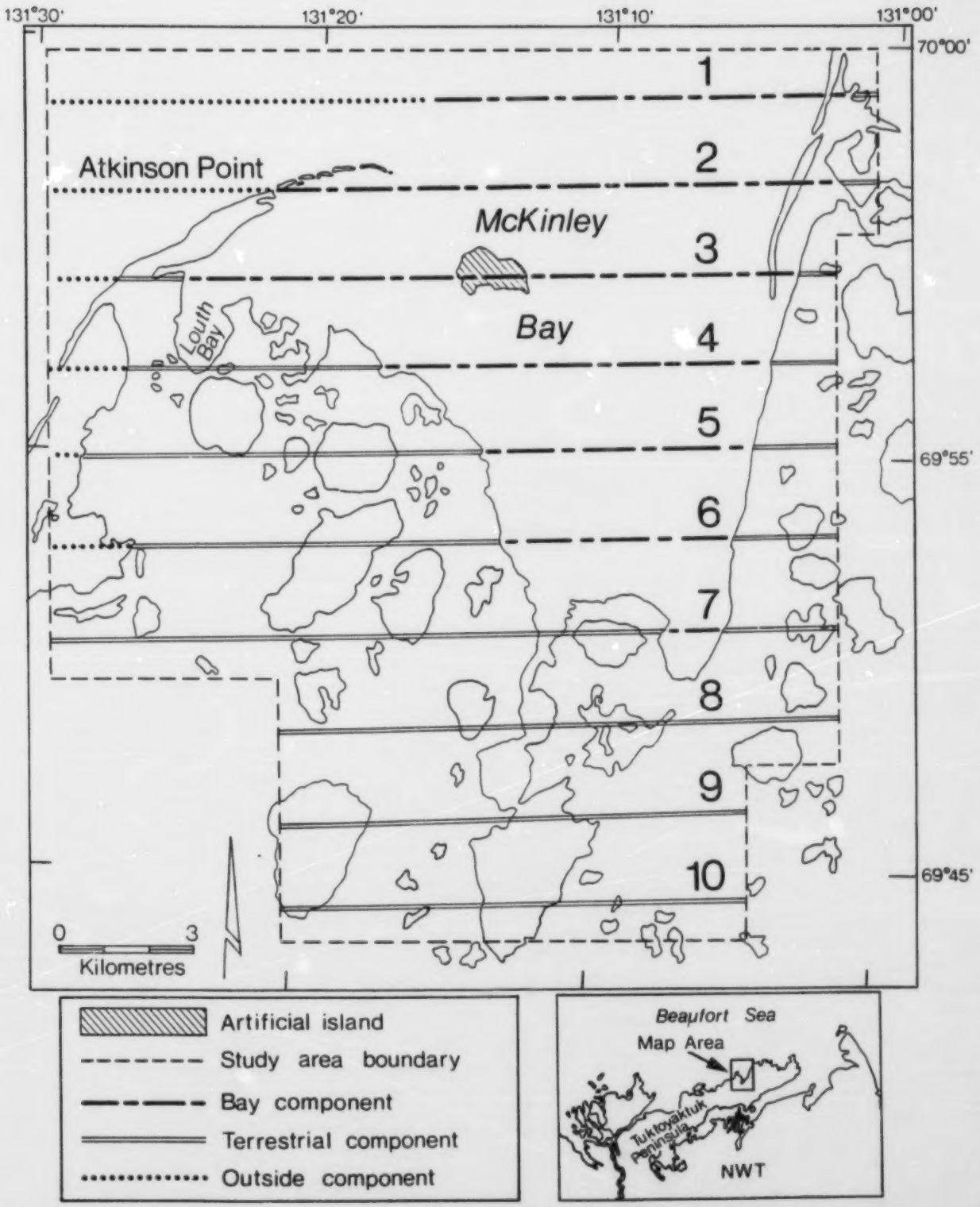

Figure 1. **Aerial transects flown at McKinley Bay on August 1, 4 and 5, 1990, showing the bay, terrestrial and outside components of the study area.**

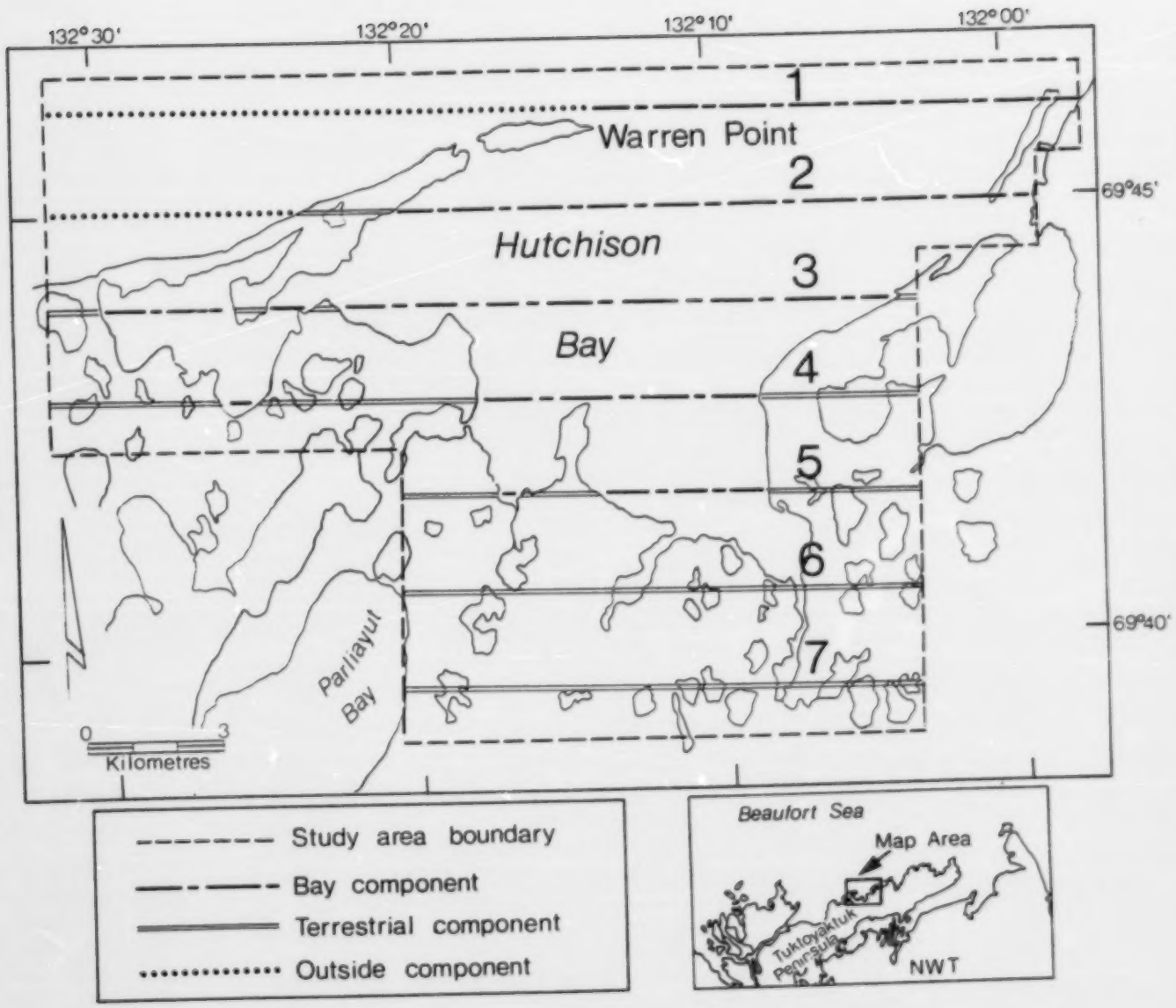

Figure 2. **Aerial transects flown at Hutchison Bay on August 1, 2 and 5, 1990, showing the bay, terrestrial and outside components of the study area.**

terrestrial component. The saltwater areas west of Warren Point and the area covered by the western half of transect 1 were considered outside component. Table 1 presents the areas of the components at Hutchison Bay and proportions surveyed.

The terms *diving ducks* and *divers* refer to ducks belonging to either Aythyinae or Merginae. References in the text to dabbling ducks or dabblers refer to surface-feeding ducks classed as Anatinae. Appendix B lists the common and scientific names of species discussed in this report.

2.2 Analysis of Data

With the systematic survey design presented above, the mean densities for each species were estimated by the standard ratio estimator. Population estimates were found through extrapolation, by multiplying the estimated mean density of birds by the total area of the study component (Table 1). Estimates of the standard errors of these variables were calculated using the method described by Kingsley and Smith (1980). These equations are summarized below.

Let N = number of possible transects in the study area
n = number of transects sampled
f = n/N
Y_i = number of observations recorded on the ith transect
X_i = area of the ith transect

Then:

(1) The standard ratio estimate $\hat{R}$ of the true mean density was given by:

$$\hat{R} = \frac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} X_i}$$

(2) The standard error of the mean density was estimated by the following:

$$\text{Standard error} = \sqrt{s_1^2}$$

$$s_1^2 = \frac{(1-f)\sum_{i=1}^{n-1}(d_i - d_{i+1})^2}{2 \cdot (n-1) \cdot n \cdot \bar{X}^2}$$

where $d = Y_i - \hat{R}X_i$

Table 1. **Aerial survey coverage of designated components of the McKinley Bay and Hutchison Bay study areas.**

Component	McKinley Bay		Hutchison Bay	
	Total Area (km^2)	Area Surveyed (km^2)	Total Area (km^2)	Area Surveyed (km^2)
Bay	108.5	19.6	100.5	17.8
Terrestrial	158.5	28.3	91.0	16.3
Outside	39.0	7.1	30.5	5.8
Total	306.0	55.0	222.0	39.9

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

(3) The standard error of the population estimate was found by multiplying $\sqrt{s_1^2}$ by the total area of the study component (Table 1).

Total observed densities of Oldsquaw, scoters and total divers in 1990 were compared to the results from 1981 to 1985, by computing t (Steel and Torrie 1980), given by:

$$t = \frac{\bar{Y}(81\text{-}85) - Y(90)}{s/\sqrt{n}}$$

where $\bar{Y}$ (81-85) = the mean density observed from 1981 to 1985 (for Hutchison Bay, from 1982-85)

Y (90) = observed density in 1990

n = 5 (McKinley Bay)

n = 4 (Hutchison Bay)

For each year, only the results from the survey with the best weather and sea conditions were included in calculations of population estimates and for data comparisons. Significant differences were accepted at $p<0.05$.

3.0 RESULTS

3.1 Survey Conditions

Aerial surveys on August 1 were conducted at McKinley and Hutchison bays between the hours of 1140 and 1455. During the surveys there was 100% cloud cover and no precipitation. However, sea conditions were moderately rough at both bays, with occasional whitecaps due to light to moderate winds from the north-northwest. Hutchison Bay was surveyed again on August 2 between 1000 and 1105, and the lighting was rated excellent, with 100% cloud cover and no precipitation. Sea conditions were calmer than on August 1, with small waves but no whitecaps, and winds were light from the west. However, McKinley Bay was not surveyed on this day, but instead on August 4. On August 4, at McKinley Bay, there was 100% cloud cover and occasional light rain. Winds were light from the west-northwest. Sea conditions were again moderate, with waves but no whitecaps. Surveys took place between 1500 and 1635 on August 4.

Both McKinley and Hutchison bays were again surveyed on August 5. At McKinley Bay, surveyed from 1255 to 1419, cloud cover was 80%, with occasional light rain. Sea conditions and winds were nearly calm. Overall conditions were rated good to excellent, so that diving ducks were easy to detect, although occasional glare sometimes interfered with species identification. Conditions at Hutchison Bay on the same day, from 1125 to 1230, were rated as excellent, with 100% cloud cover, and nearly calm sea conditions.

The August 5 surveys were rated best of the 1990 surveys, in terms of visibility for accurate counts at both bays.

3.2 Abundance of Birds

The results of the 1990 surveys are presented in detail in Appendices C and D.

3.2.1 Bay Component

3.2.1.1 Diving Ducks

Total numbers and densities of birds seen on the bay components of McKinley and Hutchison bays are presented in Tables 2 and 3. Diving ducks represented over 90% of all birds seen on the bay component during all surveys, with the exception of the survey at McKinley Bay on August 1, when 81% were divers. The average density of diving ducks at McKinley Bay over the

Table 2. **Number and density of birds observed on the bay component at McKinley Bay, 1990.** [a]

Species Group	August 1		August 4		August 5	
	Number	Density (birds/km^2)	Number	Density (birds/km^2)	Number	Density (birds/km^2)
Loons	21	1.07	11	0.56	54	2.76
Swans						
Geese			30	1.53		
Dabblers	41	2.09	4	0.20	4	0.20
Divers	2311	117.91	2875	146.68	5040	257.14
Unidentified Ducks	366	18.67			4	0.20
Shorebirds						
Jaegers						
Gulls	106	5.41	31	1.58	48	2.45
Terns	11	0.56	4	0.20	6	0.31
Total Birds	2856	145.71	2955	150.76	5156	263.06

[a] Area surveyed = 19.6 km^2. Blanks denote no birds seen

Table 3. **Number and density of birds observed on the bay component at Hutchison Bay, 1990.**[a]

Species Group	August 1		August 2		August 5	
	Number	Density (birds/km^2)	Number	Density (birds/km^2)	Number	Density (birds/km^2)
Loons	14	0.79	24	1.35	30	1.68
Swans					1	0.06
Geese	49	2.75	25	1.40	68	3.82
Dabblers	12	0.67	12	0.67	29	1.63
Divers	2414	135.62	2097	117.81	5064	284.49
Unidentified Ducks	133	7.47	182	10.22	15	0.84
Shorebirds	15	0.84				
Jaegers					1	0.06
Gulls	46	2.58	53	2.98	17	0.96
Terns	4	0.22			2	0.11
Total Birds	2687	150.96	2393	134.44	5227	293.65

[a] Area surveyed = 17.8 km^2. Blanks denote no birds seen

three surveys (174 birds/sq km) was slightly less than at Hutchison Bay (179 birds/sq km). At both bays, the largest number of diving ducks was seen on the August 5 survey, when survey conditions were considered best.

Table 4 gives the species composition of diving ducks observed at each bay on August 5. Over 90% of identified diving ducks at both bays were Oldsquaw or scoters (including White-winged Scoters, Surf Scoters and unidentified scoters). At McKinley Bay, scoters represented 49% of identified divers, and 48% were Oldsquaw. The relative proportion of Oldsquaw was greater at Hutchison Bay, where 54% of identified divers were Oldsquaw and 38% were scoters. Surf Scoters were much more frequently recorded than White-winged Scoters at both bays. On August 5, the ratio of White-winged Scoters to Surf Scoters was about 1:2 at McKinley Bay and 1:20 at Hutchison Bay (Table 4).

Other divers seen in small numbers on the bay components were scaup (2% of total identified divers at McKinley Bay, 6% at Hutchison Bay), and Red-breasted Mergansers (less than 3% at both bays) (Table 4). Although no eider were seen at either bay on August 5, they were seen in small numbers (10-12) on August 1 and 4 (Appendices C and D).

Population estimates of diving duck species observed on the bay components in 1990 are given in Table 5. The estimated population of diving ducks in McKinley Bay on August 5, 1990 was 27,900±4006. At Hutchison Bay, the population of diving ducks was estimated to be 28,591±3471.

The density estimates for Oldsquaw, scoters and total divers observed on the bay components each year from 1981 through 1985 are given in Tables 6 and 7 for McKinley Bay and Hutchison Bay, respectively. Significantly greater densities of Oldsquaw, scoters and total divers ($p<0.05$) were observed in 1990 in both McKinley and Hutchison bays than on average in each bay from 1981 to 1985 (Tables 6 and 7). At both bays, observers saw more than twice as many diving ducks in 1990. At McKinley Bay, scoters increased proportionally more than Oldsquaw, whereas at Hutchison Bay, the opposite pattern was evident.

3.2.1.2 Other Birds

Greater numbers of geese were recorded in Hutchison Bay than in McKinley Bay, on the bay component (Tables 2 and 3). Two species of geese, Brant and Greater White-fronted Geese, were recorded, although Brant were more common at both bays (Appendices C and D). No Tundra Swans were observed in McKinley Bay, and only one was observed in Hutchison Bay, on August 5.

Table 4. **Species composition of diving ducks observed on the bay component at McKinley Bay and Hutchison Bay on August 5, 1990.**

Species	McKinley Bay[a]		Hutchison Bay[b]	
	Number	Percent	Number	Percent
Oldsquaw	1713	48	2436	54
White-winged Scoter	360	10	55	1
Surf Scoter	673	19	1005	22
Scoter sp. (unidentified)	738	20	634	14
Scaup sp.	87	2	252	6
Eider sp.	0	0	0	0
Red-breasted Merganser	31	1	131	3
Total Identified Diving Ducks	3602	100.0	4513	100.0

[a] Area surveyed = 19.6 km^2

[b] Area surveyed = 17.8 km^2

Table 5. Population estimates of the diving ducks on the bay component at McKinley Bay and Hutchison Bay on August 5, 1990.

Species	Location	Total count on all transects	Density (birds/km^2)	Population estimate	Standard error of population estimate
Oldsquaw	McKinley Bay	1713	87.40	9483	2049
	Hutchison Bay	2436	136.85	13753	5307
White-winged Scoters	McKinley Bay	360	18.37	1993	1614
	Hutchison Bay	55	3.09	310	175
Surf Scoters	McKinley Bay	673	34.34	3726	1634
	Hutchison Bay	1005	56.46	5674	4461
Total Scoters[a]	McKinley Bay	1771	90.36	9804	2900
	Hutchison Bay	1694	95.17	9565	5228
Scaup sp.	McKinley Bay	87	4.44	482	209
	Hutchison Bay	252	14.16	1423	645
Red-breasted Merganser	McKinley Bay	31	1.58	171	137
	Hutchison Bay	131	7.36	740	350
Total Divers[b]	McKinley Bay	5040	257.14	27900	4006
	Hutchison Bay	5064	284.49	28591	3471

[a] Includes unidentified scoters

[b] Includes unidentified divers

Table 6. **Comparison of diving duck densities on the bay component at McKinley Bay in 1990 with historical data from 1981 to 1985.**

Species	1981-1985 Year	Observed density	Overall mean density	Standard deviation	1990 observed density	Test for difference 1990 vs mean for 1981-1985 t	p
Oldsquaw	1981	46.43					
	1982	54.23					
	1983	41.53					
	1984	46.58					
	1985	50.82					
			47.92	4.82	87.4	18.30*	<0.05
Scoters	1981	31.22					
	1982	40.05					
	1983	50.51					
	1984	74.80					
	1985	7.55					
			40.83	24.74	90.36	4.48*	<0.05
Total Divers	1981	110.82					
	1982	114.59					
	1983	117.96					
	1984	158.37					
	1985	64.18					
			113.18	33.44	257.14	9.62*	<0.05

* Significant difference

Table 7. Comparison of diving duck densities on the bay component at Hutchison Bay in 1990 with historical data from 1982 to 1985.

Species	1982-1985 Year	Observed density	Overall mean density	Standard deviation	1990 observed density	Test for difference 1990 vs mean for 1982-1985 t	p
Oldsquaw	1982	43.71					
	1983	32.47					
	1984	83.59					
	1985	48.99					
			52.19	22.04	136.70	7.67*	<0.05
Scoters	1982	64.94					
	1983	88.26					
	1984	56.52					
	1985	44.10					
			63.46	18.61	95.17	3.41*	<0.05
Total Divers	1982	133.99					
	1983	135.67					
	1984	172.25					
	1985	101.18					
			135.77	29.04	284.49	10.24*	<0.05

* Significant difference

Loons were observed in average densities of 1.5 birds/sq km in McKinley Bay, and 1.3 birds/sq. km. in Hutchison Bay for the three days of surveys. Two species of loons, Pacific Loon and Red-throated Loon, were observed in McKinley Bay, while in Hutchison Bay one Common Loon was also recorded. Red-throated Loons were more abundant than other loons (Appendices C and D).

Gulls occurred in slightly greater numbers in McKinley Bay (average density 3.2 birds/sq km) than in Hutchison Bay (average 2.2 birds/sq km). Other species groups, such as dabbling ducks, shorebirds, terns and jaegers, were encountered in small numbers on the bay component.

3.2.2 Terrestrial Component

Tables 8 and 9 list the numbers and densities of birds observed on the terrestrial components of McKinley Bay and Hutchison Bay, respectively. More species groups were represented on the terrestrial component at both bays than on the bay component.

The most abundant species group recorded on the terrestrial component at McKinley Bay was the dabbling duck, found in densities ranging from 16 to 20 (average 18) birds/sq km (Table 8). On August 1 and 4, this group accounted for about 50% of all birds observed on the terrestrial component, while on August 5, dabbling ducks represented 31% of birds seen. At Hutchison Bay, dabbling ducks were less common. Densities at Hutchison Bay ranged from 5.2 to 17 (average 10) birds/sq km, and dabblers represented a maximum of 25% (on August 2) of total birds seen on a survey (Table 9). Nearly all dabblers identified to species were Northern Pintail, although American Wigeon and, on one occasion, Mallard, were also observed in very small numbers (Appendices C and D).

Diving ducks were also commonly seen on the terrestrial component at both McKinley and Hutchison bays, but numbers varied greatly between surveys. The greatest density of diving ducks recorded at McKinley Bay was 24 birds/sq km on August 5, although only about 6 birds/sq km were recorded on the terrestrial component on the other two survey days (Table 8). At Hutchison Bay, densities of diving ducks on the terrestrial component ranged from 5 to 19 birds/sq km (Table 9). Over 60% of identified diving ducks on the terrestrial component were Oldsquaw at both bays, except on August 5 at Hutchison Bay, when scaup represented over 90% of diving ducks on the terrestrial component. Red-breasted Mergansers were also recorded in small numbers on the terrestrial component. Mergansers were more common at McKinley Bay (average density 1.9 birds/sq km) than at Hutchison Bay (average density 0.3 birds/sq km) (Appendices C and D).

Table 8. Number and density of birds observed on the terrestrial component at McKinley Bay, 1990 [a].

Species Group	August 1		August 4		August 5	
	Number	Density (birds/km^2)	Number	Density (birds/km^2)	Number	Density (birds/km^2)
Loons	49	1.73	39	1.38	62	2.19
Swans	18	0.64	45	1.59	58	2.05
Geese	37	1.31	34	1.20	122	4.31
Dabblers	468	16.54	538	19.01	566	20.00
Divers	162	5.72	184	6.50	680	24.03
Unidentified Ducks	35	1.24	14	0.49	53	1.87
Raptors	1	0.03	1	0.03	1	0.03
Ptarmigan			4	0.14		
Sandhill Cranes	15	0.53	12	0.42	3	0.11
Shorebirds	37	1.31	99	3.49	176	6.22
Jaegers	1	0.03	1	0.03		
Gulls	46	1.62	52	1.84	56	1.98
Terns	4	0.14	14	0.49	22	0.78
Owls						
Passerines					30	1.06
Total Birds	873	30.85	1037	36.64	1829	64.63

[a] Area surveyed = 28.3 km^2. Blank denotes no birds seen.

Table 9. **Number and density of birds observed on the terrestrial component at Hutchison Bay, 1990 [a].**

Species Group	August 1		August 2		August 5	
	Number	Density (birds/km^2)	Number	Density (birds/km^2)	Number	Density (birds/km^2)
Loons	32	1.96	32	1.96	41	2.52
Swans	85	5.21	66	4.05	99	6.07
Geese	65	3.99	71	4.36	80	4.91
Dabblers	85	5.21	135	8.28	282	17.30
Divers	132	8.10	76	4.66	307	18.83
Unidentified Ducks	49	3.01	43	2.64	325	19.94
Raptors	1	0.06	2	0.12		
Sandhill Cranes	11	0.67	9	0.55	4	0.24
Shorebirds	23	1.41	58	3.55	79	4.85
Jaegers	2	0.12				
Gulls	33	2.02	33	2.02	37	2.27
Terns	19	1.16	12	0.74	1	0.06
Owls	1	0.06				
Passerines						
Total Birds	538	33.01	537	32.94	1255	76.99

[a] Area surveyed = 16.3 km^2. Blank denotes no birds seen.

Swans and geese were recorded in greater numbers on the terrestrial component at Hutchison Bay than at McKinley Bay on all three survey days. Densities of Tundra Swans at McKinley Bay averaged 1.4 birds/sq km, while at Hutchison Bay, an average of 5.1 swans/sq km was observed. Numbers of geese observed on the terrestrial component at McKinley Bay varied greatly, from 34 geese on August 4 to 122 geese on August 5. At Hutchison Bay, between 65 and 80 geese were seen each day. As on the bay component, two species of geese were identified on the terrestrial component, Brant and Greater White-fronted Geese. Brant out-numbered Greater White-fronted Geese by at least 4:1 on the three days of surveys on the McKinley Bay terrestrial component, whereas at Hutchison Bay, Greater White-fronted Geese were more abundant.

Loon densities averaged 1.8 birds/sq km on the terrestrial component over the three days at McKinley Bay. At Hutchison Bay, the average density of loons was 2.2 birds/sq km. Species recorded, in order of abundance, were Red-throated and Pacific loons.

A maximum of 56 Glaucous Gulls was recorded on the McKinley Bay terrestrial component (2.0 birds/sq km.). At Hutchison Bay, the maximum observed was 37 gulls (2.3 birds/sq km.).

3.2.3 Outside Component

Detailed results of surveys of the outside components of the two study areas are presented in Appendices C and D. Few diving ducks were seen in the open areas outside of the bays on most surveys. However, on August 5 at McKinley Bay, a raft of 275 King Eiders (females except for two or three males) was recorded west of Atkinson Point on transect 1.

Gulls were frequently recorded on the outside component, especially just west of Atkinson Point. On August 1, a total of 34 Glaucous Gulls were recorded west of Atkinson Point on transect 2, and 110 Glaucous Gulls were observed off transect in the same area. On August 5, observers saw 10 Sabine's Gulls, in a small bay at the west end of transect 4. Pacific and Red-throated Loons were also recorded in small numbers on the outside component (Appendices C and D).

Large groups of geese were recorded on the outside component at McKinley Bay. Observers counted 110 Brant and 80 dark geese in the lagoon southwest of Atkinson Point on August 1. Thirty-five Brant were also recorded northwest of Atkinson Point on transect 1, on August 4. No geese were seen in the open water outside of Hutchison Bay.

3.3 Distribution of Birds

3.3.1 McKinley Bay

The distribution of selected waterfowl groups observed during the aerial surveys at McKinley Bay on August 1, 4 and 5 is presented in Figures 3, 4 and 5. Isolated groups of less than 10 diving ducks are not illustrated.

Diving Ducks

The distribution of diving ducks on the bay component at McKinley Bay varied between the three days of surveys. However, more ducks were seen in the southern and western sections of the bay than in other areas (Figs. 3, 4 and 5).

Scoters and Oldsquaw showed different patterns of distribution in the bay. On August 1 and 4, over 70% of all observed scoters were on transects 6 and 7 in the south end of the bay. However, on August 5, only 31% of scoters occurred on these two transects; scoters were also found in large numbers at the western end of transects 3, 4 and 5 on this day. Oldsquaw were more scattered across the bay than were scoters on all three days of surveys. They were found in varying numbers in most areas of the bay, except northeast of the artificial island. Large numbers of Oldsquaw were consistently seen on transect 4 south of the artificial island, and in the area between the artificial island and Atkinson Point. Oldsquaw also occurred frequently in the south end of the bay, but in smaller numbers than scoters. Both Oldsquaw and scoters utilized the area near a long narrow spit at the east end of transect 3 (Figs. 3, 4, and 5).

Scaup and Red-breasted Mergansers nearly always occurred close to shore. They were most common just south of Atkinson Point, at the south end of the bay on transects 6 and 7, and inside the long narrow spit at the east end of the bay, on transects 2 or 3 (where 90 scaup were observed on August 4).

On the terrestrial component, diving ducks were distributed on the larger lakes south of McKinley Bay and on the lagoon system entering the south end of the bay. Nearly all divers observed on the terrestrial component were Oldsquaw, scaup or Red-breasted Mergansers. On August 5, three large flocks of over 100 Oldsquaw were seen on lakes on transects 5, 6 and 8 (Fig. 5). Red-breasted Mergansers favoured the lagoon system and were noted there on all three surveys (a maximum of 87 on August 5).

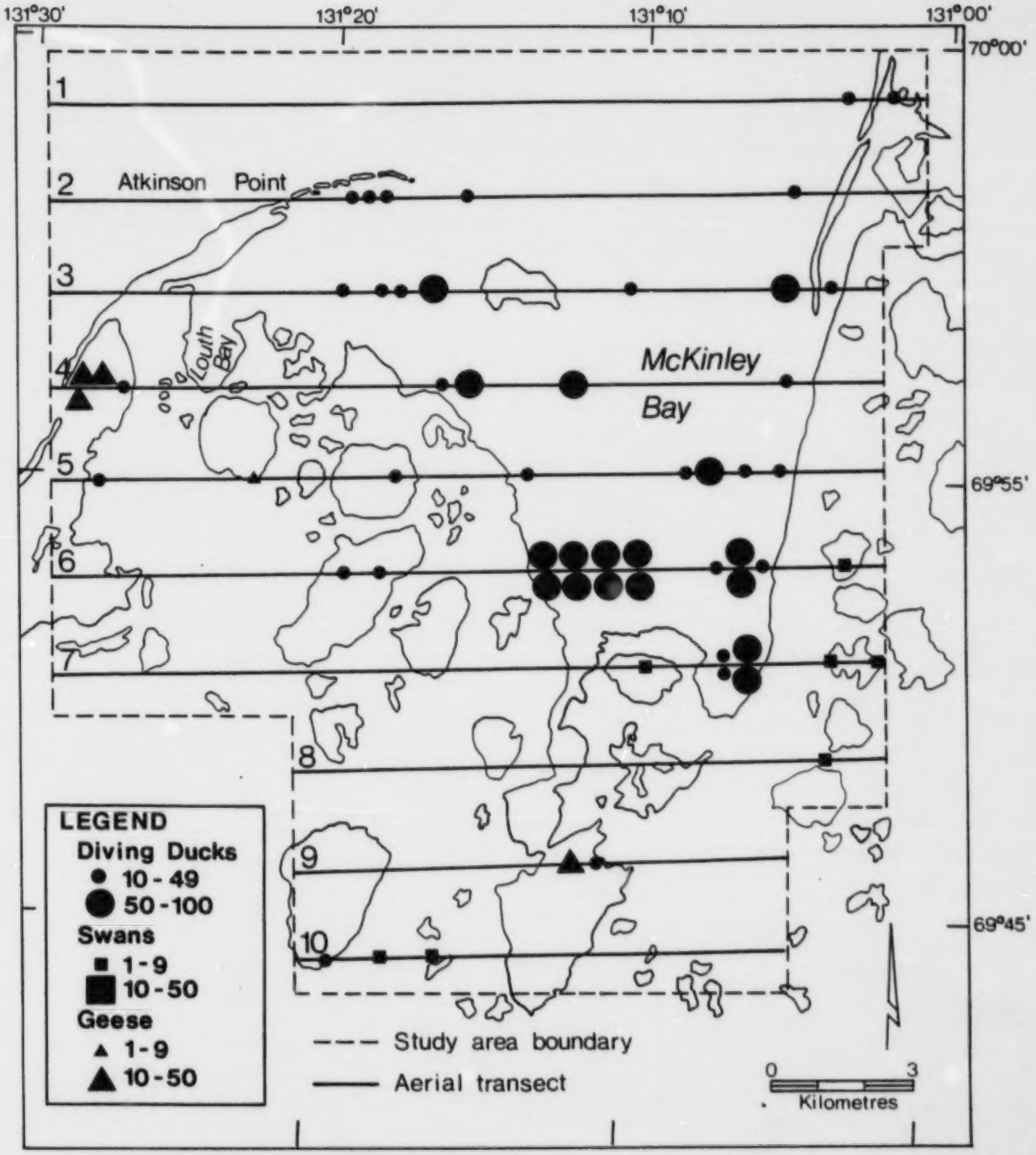

Figure 3. **Distribution of waterfowl observed on aerial transects at McKinley Bay on August 1,1990.**

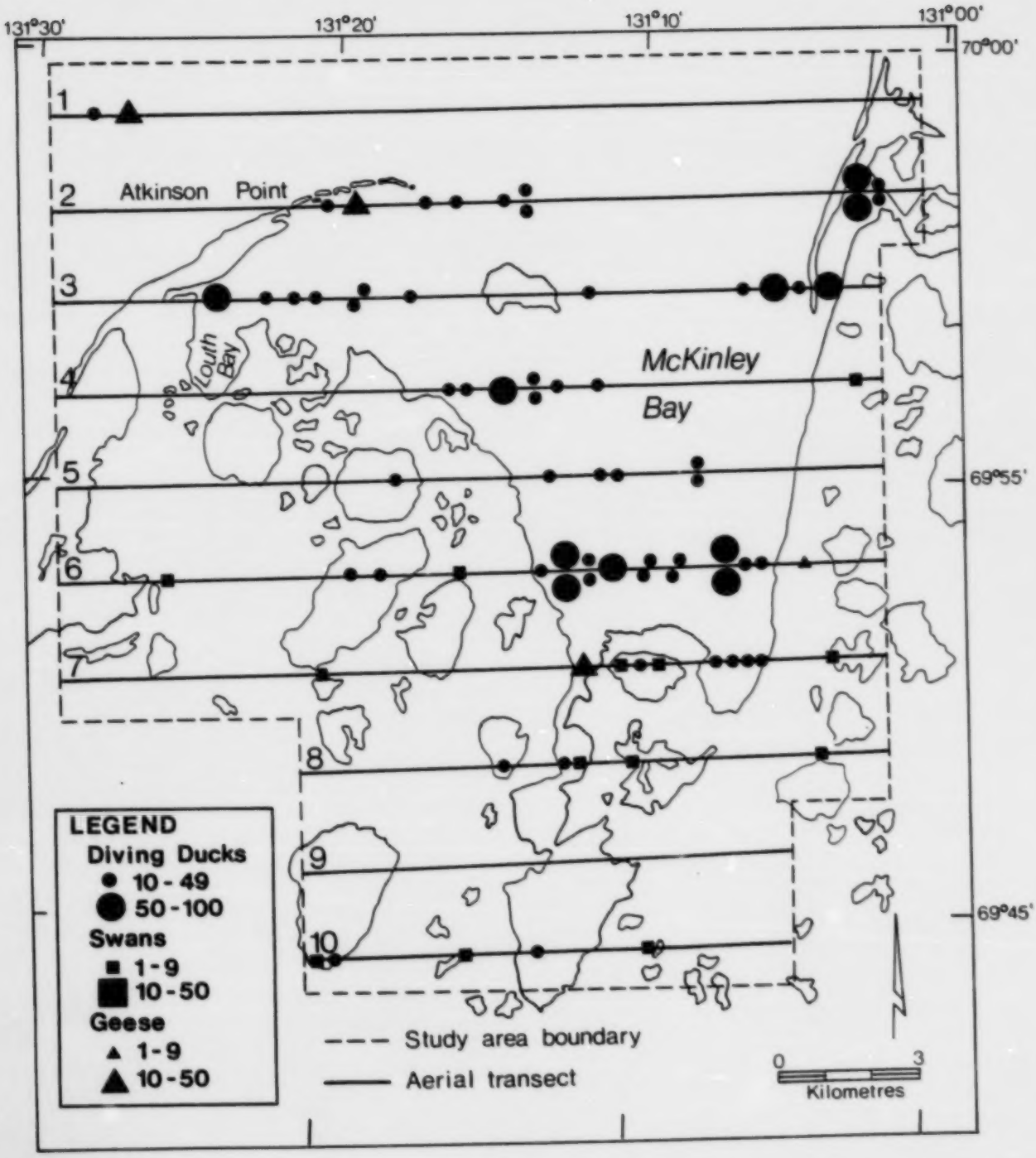

Figure 4. Distribution of waterfowl observed on aerial transects at McKinley Bay on August 4,1990.

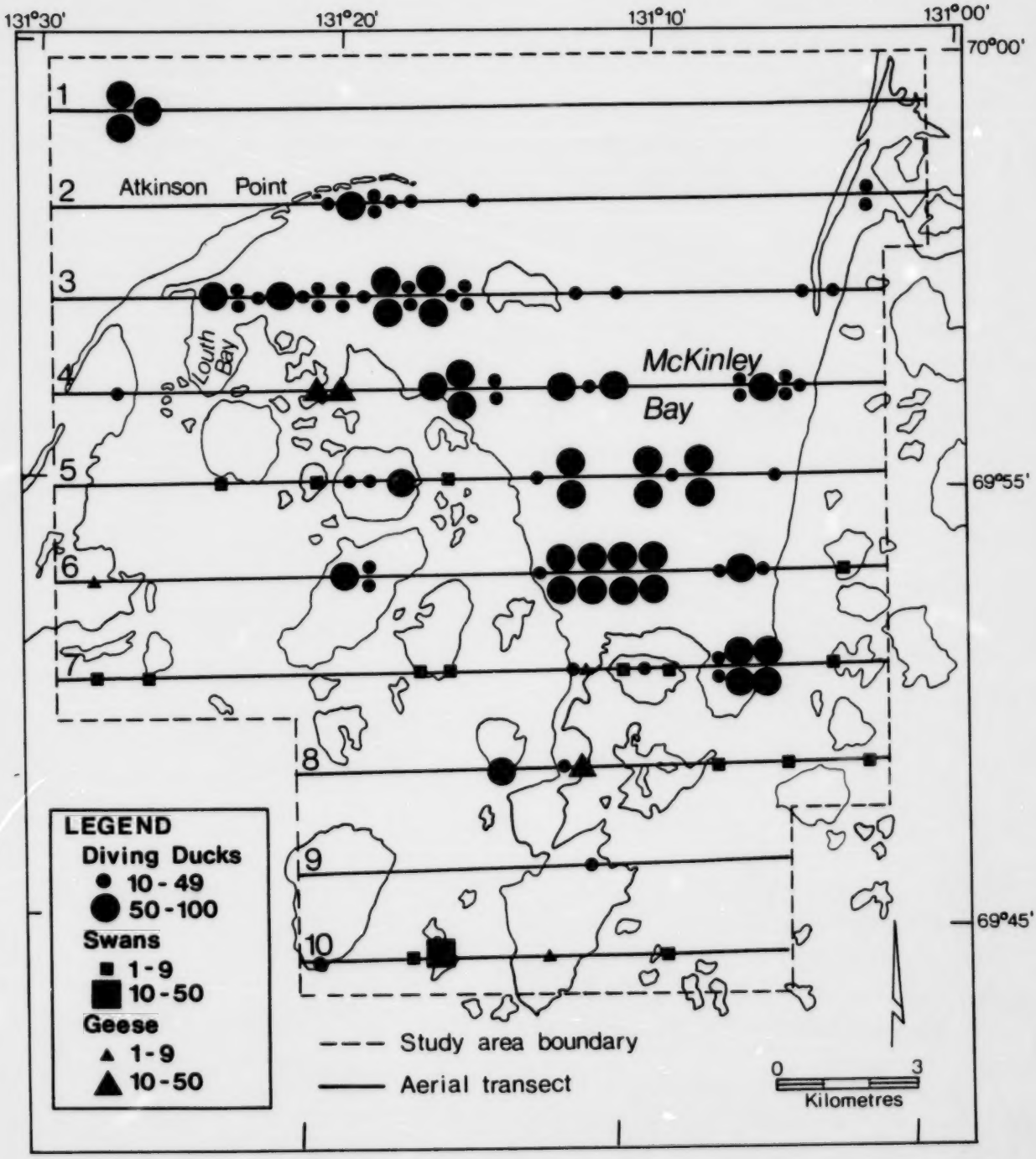

Figure 5. **Distribution of waterfowl observed on aerial transects at McKinley Bay on August 5, 1990.**

Other Birds

Several sections of the McKinley Bay study area were utilized by geese. Three areas appeared to be especially important, in terms of numbers of observations. These were: the lagoon system at the south end of the bay, where groups of 20-35 Brant were observed on each survey; the tidal flats east of Louth Bay, where a total of 22 Greater White-fronted Geese and 75 Brant were seen on August 5; and a protected lagoon area at the west end of transects 4 and 5, on the outside component, where on August 1, a total of 200 geese (mostly Brant) were recorded. Geese were also observed in the vicinity of the spit at Atkinson Point (Figs. 3, 4 and 5). Small numbers of Greater White-fronted Geese occurred on lakes in the terrestrial component.

Tundra Swans were recorded on lakes and tundra ponds throughout the study area, generally in pairs and small family groups. The largest group of swans noted in one location was a group of 18 on a lake east of the lagoon system, on transect 10.

Dabbling ducks, primarily Northern Pintails (not mapped on figures), were distributed in small groups on lakes, tundra ponds and shallow lagoon areas. Dabbling ducks were especially common in the lagoon system at the south end of the study area, at the east end of transect 2 and on transects 7 and 8.

Glaucous Gulls (not mapped) were most common near the spit at Atkinson Point, especially on transect 2. On August 1, over 70 Glaucous Gulls were seen on the south side of the spit, and another 34 gulls on the eastern tip.

3.3.2 Hutchison Bay

Figures 6,7 and 8 show the distribution of selected waterfowl groups observed at Hutchison Bay on August 1, 2 and 5, 1990.

Diving Ducks

Diving ducks were seen throughout the bay component of Hutchison Bay, but several consistent patterns of distribution were evident. Divers were consistently recorded in large numbers just south or southeast of Warren Point. From 50-65% of all scoters in the bay component occurred there, including a raft of over 800 scoters on August 5.

Oldsquaw in Hutchison Bay were more scattered than scoters, although Oldsquaw densities were relatively greater near the east shore than in other areas. On August 5, a tight flock of over 500 Oldsquaw was recorded near the east end of transect 3, along with 2 other large flocks

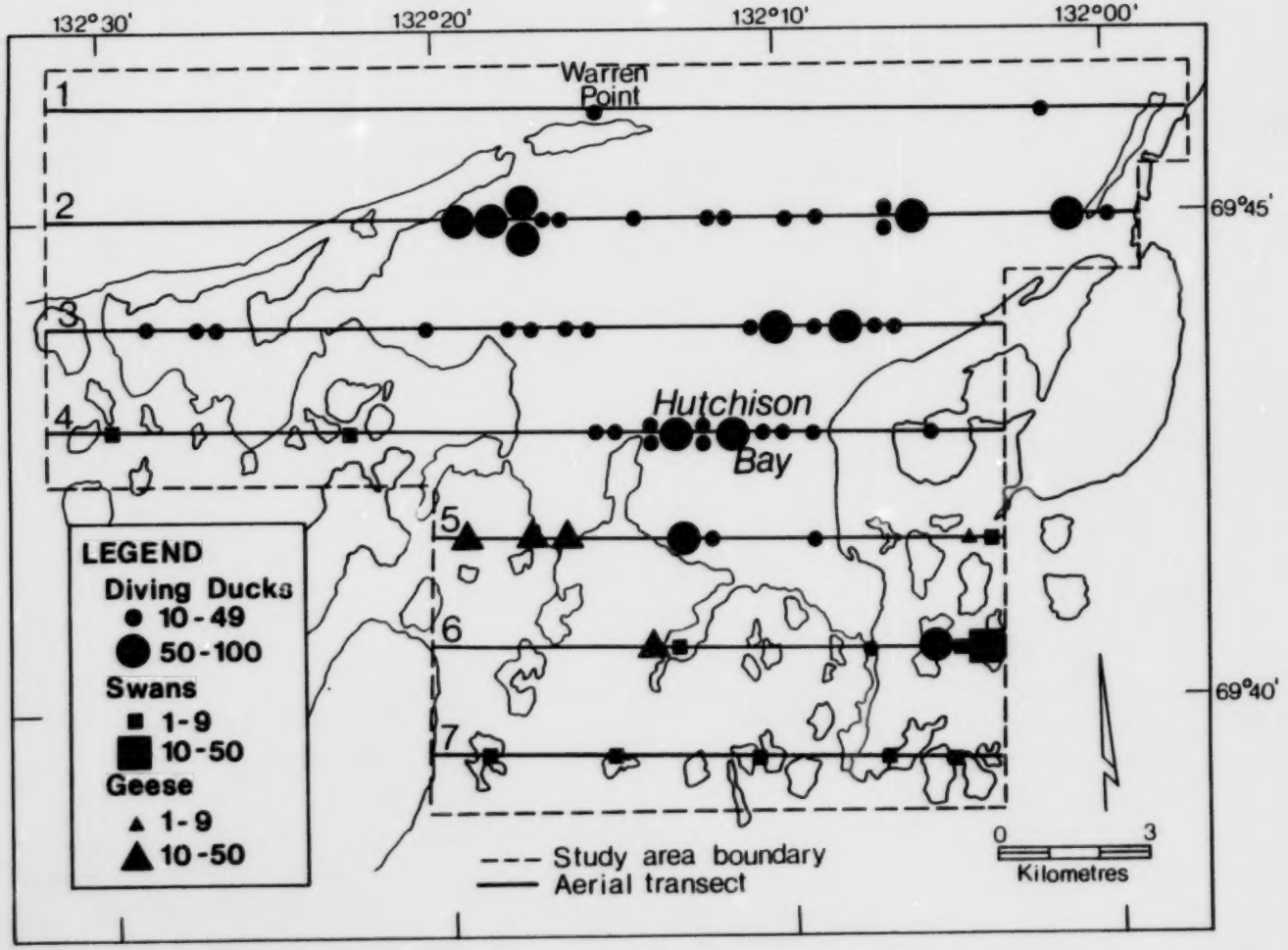

Figure 6. **Distribution of waterfowl observed on aerial transects at Hutchison Bay on August 1, 1990.**

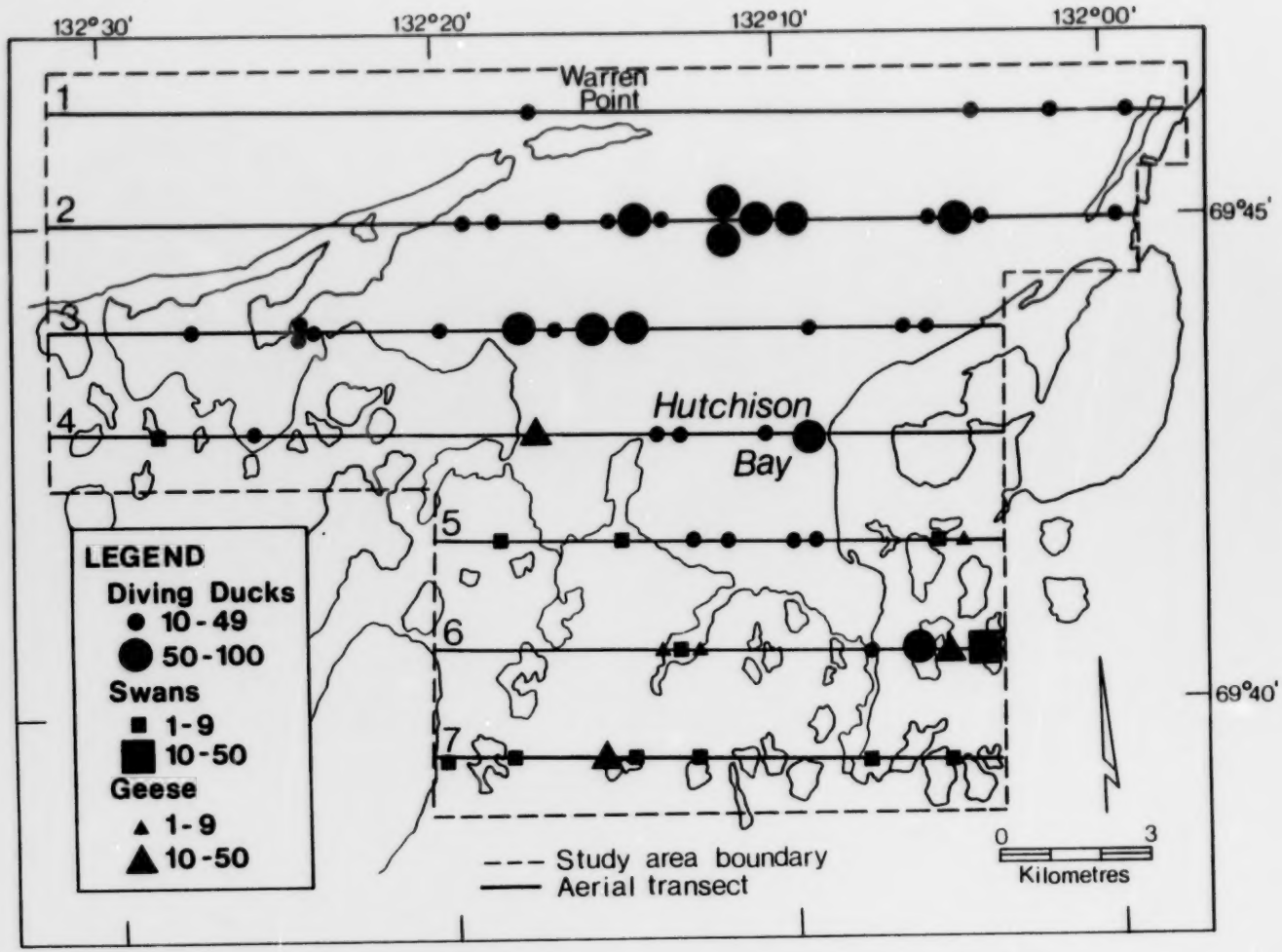

Figure 7. **Distribution of waterfowl observed on aerial transects at Hutchison Bay on August 2, 1990.**

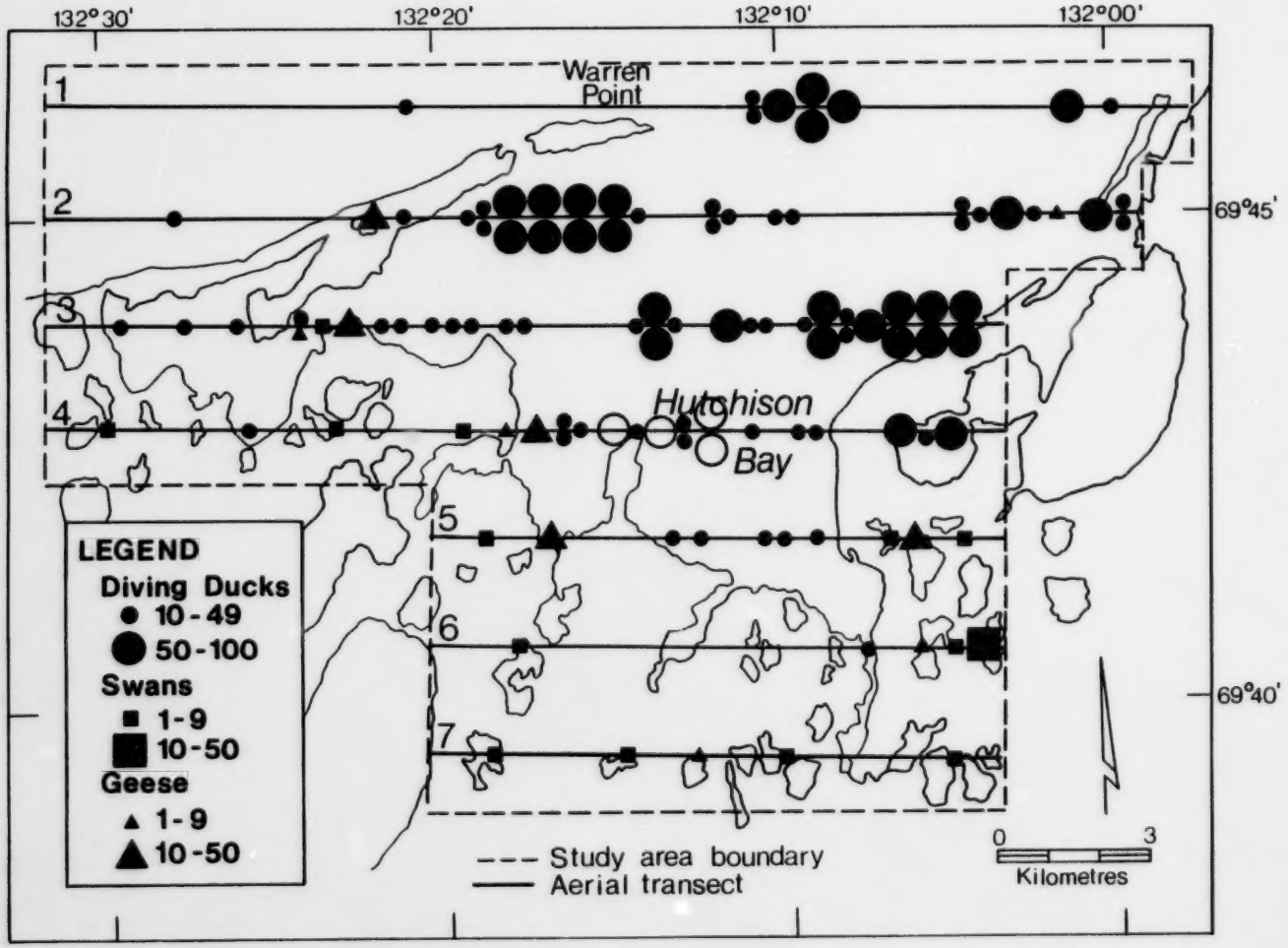

Figure 8. **Distribution of waterfowl observed on aerial transects at Hutchison Bay on August 5, 1990.**

of 100 Oldsquaw. Oldsquaw also occurred in small numbers in the western arm of the bay, where scoters were less frequently recorded.

Scaup and Red-breasted Mergansers on the bay component were generally found in protected areas near shore. Both scaup (up to 90) and mergansers (up to 70) were recorded just west of a peninsula jutting into the south of the bay. Both species also frequented the sheltered areas inside a long spit at the east end of transect 2 (up to 50 scaup and 25 mergansers). Other areas where these species were recorded include the western arm of the bay and the south end of the bay (where a maximum of 60 scaup were recorded on transect 5 each survey).

The distribution of divers on the terrestrial component at Hutchison Bay was much more restricted than at McKinley Bay. Divers at Hutchison Bay were concentrated mainly in two areas: on a lake just east of the bay, on transect 6 (50 to 80 Oldsquaw on August 1 and 2); and on a protected lagoon east of Hutchison Bay, on transect 4 (about 160 scaup on August 5). A few scaup and Red-breasted Mergansers (less than 15) were also seen on the lagoon at the south end of the bay, and a few Oldsquaw rested on the spit at Warren Point on August 5. No scoters were observed on the terrestrial component.

Other Birds

As at McKinley Bay, geese were more frequently observed on the terrestrial component than on the bay component. The largest concentrations of geese occurred on lakes and lagoon areas on transects 5, 6 and 7, where groups of up to 45 Greater White-fronted Geese were observed (Figs. 6, 7 and 8). Geese were also seen in the small bay west of the peninsula that juts into the south end of Hutchison Bay. A group of 25 Brant was seen there on all three surveys, and on August 5, 19 Greater White-fronted Geese, 60 Brant, and 5 dark geese were also seen in this location.

Tundra Swans were scattered on lakes and ponds across the terrestrial component of the study area (Figs. 6, 7 and 8). Large numbers of swans, totalling up to 60, were recorded on a lake at the east end of transect 6 on all three days. These were primarily adults.

Dabbling ducks (not mapped on figures) were scattered on lakes and ponds on the terrestrial component of the study area, or occasionally close to shore within the bay. They were primarily Northern Pintail, although American Wigeon (15) and Mallard (1) were observed on a lake at the east end of transect 6 on August 5.

Although found throughout the Hutchison Bay study area, Glaucous Gulls and Arctic Terns (not mapped) tended to concentrate on the spit at Warren Point, as well as a long narrow spit at the east end of transect 1. A relatively large number of Arctic Terns (11) was observed on transect 7 east of the lagoon channel, in the southeast corner of the study area.

3.4 Flocks Sizes of Oldsquaw and Scoters

Table 10 gives the distribution of Oldsquaw and scoters in flocks of different sizes, based on data from the August 5, 1990 surveys at McKinley and Hutchison bays. More than 50% of Oldsquaw were in smaller flocks of less than 50 birds, whereas scoters tended to occur in larger flocks. The largest identified flock encountered at McKinley Bay was 200 scoters. However, at Hutchison Bay, two flocks of over 400 birds were recorded, a flock of 550 Oldsquaw and a flock of 800 scoters.

Table 10. Distribution of Oldsquaw and scoters in flocks of different sizes at McKinley Bay and Hutchison Bay during aerial surveys on August 5, 1990.

Flock Size	Bay	Oldsquaw		Scoters	
		No.	Percent	No.	Percent
Less than 10 birds	MB[a]	264	15	123	7
	HB[b]	284	12	165	10
10-49 birds	MB	739	43	503	29
	HB	1032	42	509	30
50-99 birds	MB	320	19	360	20
	HB	225	10	120	7
100-399 birds	MB	390	23	785	44
	HB	345	14	100	6
400 or more birds	MB	0	-	0	-
	HB	550	22	800	47
Total Observed	MB	1713	100	1771	100
	HB	2436	100	1694	100

[a] MB = McKinley Bay

[b] HB = Hutchison Bay

4.0 DISCUSSION

More than twice as many diving ducks occurred in McKinley Bay and Hutchison Bay during aerial surveys in 1990 than on the average during the five years of the initial phase of the study, from 1981 through 1985. However, dramatic fluctuations in numbers of divers were also recorded from 1981 to 1985 (Cornish and Dickson 1986). For example, the number of Oldsquaw more than doubled between 1983 and 1984 at Hutchison Bay, while numbers of scoters recorded at McKinley Bay in 1985 represented about one-tenth the number observed during the 1984 survey. Other researchers have similarly encountered large year-to-year fluctuations in numbers of moulting diving ducks observed during aerial surveys repeated at approximately the same time each year. For example, during a series of aerial surveys conducted at the end of July in the three years from 1977 to 1979 at Simpson Lagoon in the Alaskan Beaufort Sea, estimates of the number of Oldsquaw present each year varied from 12, 068 to 51, 375 (Johnson and Richardson 1981).

The increase in abundance of diving ducks at McKinley Bay was likely unrelated to any changes in the level of industrial activity in the bay, since a similar increase occurred in Hutchison Bay, the control area. Many factors, including both environmental factors such as those affecting nesting success and timing of the moult, and factors related to the survey methods, could be involved in causing the large fluctuations in numbers of moulting diving ducks along the Tuktoyaktuk Peninsula. These have been discussed in an earlier report (Cornish and Dickson 1986).

The distribution of divers observed at McKinley Bay during 1990 surveys was similar to the pattern observed in previous years (Cornish and Dickson 1986). Areas of the bay most heavily utilized by diving ducks were:

- the south end of the bay on transects 5, 6 and 7 (especially scoters);
- the area south of Atkinson Point spit, included in transects 2 and 3;
- a region of transect 4 south of the artificial island; and
- near a long narrow spit in the northeast corner of the bay.

Greater food availability and physical protection from wind and waves are probable factors determining the observed distribution. A discussion of these factors is included in Cornish and Dickson (1986).

At Hutchison Bay, the patterns of distribution observed in 1990 were not as clearly similar to patterns observed in earlier years of surveys. However, high densities of diving ducks were

consistently observed in the area south of Warren Point on transects 2 and 3 during all years of surveys.

The tendency of scoters to aggregate into large flocks of more than 50 birds was also noted in the 5-year initial phase of the study (Cornish and Dickson 1986). However, in 1990, more Oldsquaw were observed in large flocks than during the surveys from 1981 to 1985.

Eider were rarely recorded during the 1990 surveys, nor during the 1981-1985 surveys. According to Barry (1986), most of the eiders in the Beaufort Sea probably moult in the Chukchi Sea. The large raft of 275 King Eiders (mainly females) observed west of Atkinson Point in 1990 were probably failed breeders that were migrating westward to moult.

Numbers of loons, swans, and geese observed in 1990 were similar to that observed on the average in 1981 through 1985 at McKinley Bay on the terrestrial component (Cornish and Dickson 1986). Densities of dabbling ducks were consistently higher at McKinley Bay during all three aerial surveys in 1990 than in the period five to ten years prior.

On the Hutchison Bay terrestrial component, increased numbers of swans and geese were observed on all three surveys in 1990 compared to 1981-1985, while densities of loons, dabblers and gulls were similar between the two phases of the study.

Geese were recorded in many of the same areas in 1990 as in the earlier years of the study. Areas consistently utilized by geese at McKinley Bay were the littoral flats east of Louth Bay, the long lagoon channel at the south end of the bay, and, less commonly, near Atkinson Point. These are apparently important feeding and resting sites for geese. The McKinley Bay area is known to support several nesting colonies of Brant: in 1984, Arner et al (1985) noted 6 Brant colonies with a total of 65 nests in an area within the west half of our study area. All of the colonies were located near tidal flats.

Slightly higher numbers of gulls were observed on the bay components at both study areas in 1990 than from 1981 to 1985. Both regions are utilized by breeding and non-breeding gulls (Alexander et al 1988). Gull colonies are known to occur on several sandy spits adjacent to these bays (Alexander et al 1988), and several colonies were recorded on lakes in the McKinley Bay study area in 1984, often near Brant colonies (Arner et al 1985).

The existence of diving duck moulting areas separate from the nesting grounds is an ecological adaptation that ultimately serves to increase brood survival in diving ducks (Salomonsen 1968). The 1990 aerial surveys at McKinley Bay and Hutchison Bay confirm that these areas are extremely important for moulting Oldsquaws and scoters in early August. The 1990 results

contribute to the set of baseline data on numbers of diving ducks and other birds that utilize these coastal bays.

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APPENDIX A. INDUSTRIAL ACTIVITY IN MCKINLEY BAY

Development and use of McKinley Bay as a winter harbour

An entrance channel and mooring basin were dredged in the northeast section of McKinley Bay in September of 1979. This was followed in 1980 by construction of a more sheltered mooring area, southwest of the original location. An artificial island was created to the north of the new location with the dredged spoils, to further protect the moored ships from storms and ice movement. In 1981, docking facilities were constructed, and the artificial island and mooring basin were expanded. Major activity directed towards continuing the development of the harbour has not occurred since 1981. Appendix A1 summarizes the activities associated with industrial use of the bay from 1985-1990 (N. Vanderkooy, Canadian Marine Drilling Ltd., pers. comm.).

A total of 19 oil spills were reported in McKinley Bay in 1979 and 1980, the period prior to initiation of the monitoring program (Spill Reports, Indian and Northern Affairs Canada, Yellowknife). Fourteen of these spills were less than 50 gallons. The largest spill which was 500 gallons occurred after freeze-up. From 1981 to 1985, 16 oil spills were reported, 11 of which occurred in 1982. The largest spills were 1100 and 7000 gallons, both of which again occurred after freeze-up. Three of the remaining spills were 300 to 400 gallons, and 6 were less than 50 gallons. Four small spills of less than 25 gallons were reported within McKinley Bay during the period from 1986 to 1989, and none occurred in 1990. There have been no reported oil spills in Hutchison Bay from 1979 to present.

Appendix A1. Industrial activities associated with winter harbour and petroleum exploration support base at McKinley Bay, NWT, 1985-1990.[a]

Activity	Year					
	1985	1986	1987	1988	1989	1990
No. of ships winterized	17	17	11	8	11	9
No. of ships mobilized	17	13	7	6	5	4
Dredging activity	none	none	none	none	none	none
Island camp	closed	closed	closed	closed	closed	closed
Drydock complex:						
Staff	44	44	44	44	60	44
Days operating	110	110	110	110	110	110
Flights	Daily	Daily	3/week	3/week	Daily	3/week

[a] N. Vanderkooy, Canadian Marine Drilling Ltd., pers. comm.

APPENDIX B. SCIENTIFIC NAMES OF SPECIES OF BIRDS OBSERVED AT MCKINLEY BAY AND HUTCHISON BAY DURING AERIAL SURVEYS IN 1990.

Common Name	Scientific Name
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Tundra Swan	*Cygnus columbianus*
Greater White-fronted Goose	*Anser albifrons*
Brant	*Branta bernicla*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
American Wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Scaup sp.	*Aythya sp.*
King Eider	*Somateria spectabilis*
Common Eider	*Somateria mollissima*
Oldsquaw	*Clangula hyemalis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Red-breasted Merganser	*Mergus serrator*
Northern Harrier	*Circus cyaneus*
Rough-legged Hawk	*Buteo lagopus*
Gyrfalcon	*Falco rusticolus*
Willow Ptarmigan	*Lagopus lagopus*
Ptarmigan sp.	*Lagopus sp.*
Sandhill Crane	*Grus canadensis*
Whimbrel	*Numenius phaeopus*
Stilt Sandpiper	*Calidris himantopus*
Red-necked Phalarope	*Phalaropus lobatus*
Phalarope sp.	*Phalaropus sp.*
Pectoral Sandpiper	*Calidris melanotos*
Parasitic Jaeger	*Stercorarius parasiticus*
Jaeger sp.	*Stercorarius sp.*
Glaucous Gull	*Larus hyperboreus*
Sabine's Gull	*Xema sabini*
Arctic Tern	*Sterna paradisaea*
Short-eared Owl	*Asio flammeus*

APPENDIX C. BIRDS OBSERVED ON AERIAL SURVEYS AT MCKINLEY BAY IN AUGUST, 1990.

Appendix C1. Birds observed on the bay component of aerial surveys at McKinley Bay on August 1, 1990[a].

Species	Transect Number							Total on all transects
	1	2	3	4	5	6	7	
Pacific Loon					6			6
Red-throated Loon		2	11					13
Common Loon								
Loon sp.			2					2
Tundra Swan								
Brant								
Greater White-fronted Goose								
Dark Goose								
Mallard								
Northern Pintail	14	2		25				41
American Wigeon								
Dabbling Duck								
Scaup sp.						5	12	17
King Eider								
Common Eider	12							12
Eider sp.								
Oldsquaw		210	346	76	175	258	32	1097
White-winged Scoter						158		158
Surf Scoter		34	81	50	45	307	156	673
Scoter sp.	7		4	60	18	135	84	308
Red-breasted Merganser	5		1					6
Diving Duck				40				40
Unidentified Duck		8	83	75		200		366
Northern Harrier								
Rough-legged Hawk								
Gyrfalcon								
Willow Ptarmigan								
Ptarmigan sp.								
Sandhill Crane								
Whimbrel								
Stilt Sandpiper								
Red-necked Phalarope								
Phalarope sp.								
Pectoral Sandpiper								
Shorebird								
Parasitic Jaeger								
Jaeger sp.								
Glaucous Gull		82	10	14				106
Sabine's Gull								
Arctic Tern	1	9	1					11
Short-eared Owl								
Passerine								
All Species	39	347	539	340	244	1063	284	2856
Km Surveyed	8.5	12.0	13.25	8.5	5.75	5.0	1.5	

[a] Blank denotes no birds seen.

Appendix C2. Birds observed on the bay component of aerial surveys at McKinley Bay on August 4, 1990[a].

Species	Transect Number							Total on all transects
	1	2	3	4	5	6	7	
Pacific Loon								
Red-throated Loon		3	1	6	1			11
Common Loon								
Loon sp.								
Tundra Swan								
Brant								
Greater White-fronted Goose								
Dark Goose		30						30
Mallard								
Northern Pintail	4							4
American Wigeon								
Dabbling Duck								
Scaup sp.		117	8	7		7	59	198
King Eider								
Common Eider						10		10
Eider sp.								
Oldsquaw		344	390	250	137	160	40	1321
White-winged Scoter				9			2	11
Surf Scoter			68	9	2	124	8	211
Scoter sp.		75	55	25	48	574	27	804
Red-breasted Merganser		20	1					21
Diving Duck		81	166	30	2	20		299
Unidentified Duck								
Northern Harrier								
Rough-legged Hawk								
Gyrfalcon								
Willow Ptarmigan								
Ptarmigan sp.								
Sandhill Crane								
Whimbrel								
Stilt Sandpiper								
Red-necked Phalarope								
Phalarope sp.								
Pectoral Sandpiper								
Shorebird								
Parasitic Jaeger								
Jaeger sp.								
Glaucous Gull		18			9	2	2	31
Sabine's Gull								
Arctic Tern	4							4
Short-eared Owl								
Passerine								
All Species	8	688	689	336	199	897	138	2955
Km Surveyed	8.5	12.0	13.25	8.5	5.75	5.0	1.5	

[a] Blank denotes no birds seen.

Appendix C3. Birds observed on the bay component of aerial surveys at McKinley Bay on August 5, 1990[a].

Species	Transect Number							Total on all transects
	1	2	3	4	5	6	7	
Pacific Loon		1	3	4		3		11
Red-throated Loon	2	2	8	7	8	10		37
Common Loon								
Loon sp.	1				5			6
Tundra Swan								
Brant								
Greater White-fronted Goose								
Dark Goose								
Mallard								
Northern Pintail				4				4
American Wigeon								
Dabbling Duck								
Scaup sp.		15	22		5		45	87
King Eider								
Common Eider								
Eider sp.								
Oldsquaw	3	169	644	492	145	240	20	1713
White-winged Scoter		2	50	3	290		15	360
Surf Scoter			220	32		61	360	673
Scoter sp.	4	19	278	235	85	41	76	738
Red-breasted Merganser				6		25		31
Diving Duck		218	236	135	154	690	5	1438
Unidentified Duck							4	4
Northern Harrier								
Rough-legged Hawk								
Gyrfalcon								
Willow Ptarmigan								
Ptarmigan sp.								
Sandhill Crane								
Whimbrel								
Stilt Sandpiper								
Red-necked Phalarope								
Phalarope sp.								
Pectoral Sandpiper								
Shorebird								
Parasitic Jaeger								
Jaeger sp.								
Glaucous Gull	1	35	5	3	1	2	1	48
Sabine's Gull								
Arctic Tern	2	4						6
Short-eared Owl								
Passerine								
All Species	13	465	1466	922	693	1072	526	5156
Km Surveyed	8.5	12.0	13.25	8.5	5.75	5.0	1.5	

[a] Blank denotes no birds seen.

Appendix C4. Birds observed on the terrestrial component of aerial surveys at McKinley Bay on August 1, 1990[a].

Species	Transect Number										Total on all transects
	1	2	3	4	5	6	7	8	9	10	
Pacific Loon						5	2				7
Red-throated Loon			4	5	12	3	12		1	1	38
Common Loon											
Loon sp.						3			1		4
Tundra Swan						3	10	1		4	18
Brant									35		35
Greater White-fronted Goose					2						2
Dark Goose											
Mallard											
Northern Pintail		23		28	30	24	175	124	39	25	468
American Wigeon											
Dabbling Duck											
Scaup sp.						26					26
King Eider											
Common Eider											
Eider sp.											
Oldsquaw					46	42	9	1		15	113
White-winged Scoter											
Surf Scoter							1				1
Scoter sp.					6						6
Red-breasted Merganser								1	15		16
Diving Duck											
Unidentified Duck	4		3		25		3				35
Northern Harrier						1					1
Rough-legged Hawk											
Gyrfalcon											
Willow Ptarmigan											
Ptarmigan sp.											
Sandhill Crane				3		3	6	1		2	15
Whimbrel											
Stilt Sandpiper											
Red-necked Phalarope											
Phalarope sp.											
Pectoral Sandpiper					1						1
Shorebird					25	5		1	5		36
Parasitic Jaeger										1	1
Jaeger sp.											
Glaucous Gull			1	4		18	13	1	7	1	45
Sabine's Gull							1				1
Arctic Tern									3	1	4
Short-eared Owl											
Passerine											
All Species	4	23	8	40	147	133	232	130	106	50	873
Km Surveyed	0.25	1.0	2.25	6.75	1075	1025	15.5	12.0	10.0	10.0	

[a] Blank denotes no birds seen.

Appendix C5. Birds observed on the terrestrial component of aerial surveys at McKinley Bay on August 4, 1990[a].

Species	Transect Number										Total on all transects
	1	2	3	4	5	6	7	8	9	10	
Pacific Loon					2				1		3
Red-throated Loon			2	2	8	2	11	4	4	2	35
Common Loon											
Loon sp.									1		1
Tundra Swan				4		3	17	5		16	45
Brant							30				30
Greater White-fronted Goose						4					4
Dark Goose											
Mallard											
Northern Pintail	3	84		10	59	26	132	78	47	28	467
American Wigeon							2				2
Dabbling Duck				7	12	18	11	8	13		69
Scaup sp.						8				15	23
King Eider											
Common Eider											
Eider sp.											
Oldsquaw					20	40	20	25			105
White-winged Scoter											
Surf Scoter											
Scoter sp.											
Red-breasted Merganser								9		35	44
Diving Duck								10	2		12
Unidentified Duck					10		4				14
Northern Harrier											
Rough-legged Hawk										1	1
Gyrfalcon											
Willow Ptarmigan									3		3
Ptarmigan sp.					1						1
Sandhill Crane				3	1	2	1	5			12
Whimbrel									1		1
Stilt Sandpiper											
Red-necked Phalarope							40				40
Phalarope sp.											
Pectoral Sandpiper											
Shorebird				29	8	1	4	8	1	7	58
Parasitic Jaeger					1						1
Jaeger sp.											
Glaucous Gull		1			6	8	21	6	6	2	50
Sabine's Gull								1	1		2
Arctic Tern				4				2	8		14
Short-eared Owl											
Passerine											
All Species	3	85	2	59	128	112	293	161	88	106	1037
Km Surveyed	0.25	1.0	2.25	6.75	1075	1025	15.5	12.0	10.0	10.0	

[a] Blank denotes no birds seen.

Appendix C6. Birds observed on the terrestrial component of aerial surveys at McKinley Bay on August 5, 1990[a].

Species	Transect Number										Total on all transects
	1	2	3	4	5	6	7	8	9	10	
Pacific Loon		2		3	1	1	6		1		14
Red-throated Loon			2	3	8	6	13	5	4	2	43
Common Loon											
Loon sp.			2		2			1			5
Tundra Swan					7	3	20	5		23	58
Brant				75				20			95
Greater White-fronted Goose				22						1	23
Dark Goose								4			4
Mallard											
Northern Pintail		34	5	16	126	37	176	85	51	2	532
American Wigeon							3		8		11
Dabbling Duck		1		5				8		9	23
Scaup sp.					20	41	3				64
King Eider											
Common Eider											
Eider sp.											
Oldsquaw					146	169	22	100		3	440
White-winged Scoter					10						10
Surf Scoter											
Scoter sp.					4						4
Red-breasted Merganser							10	50	42		102
Diving Duck					7	20	16	7		10	60
Unidentified Duck						30	13	5	5		53
Northern Harrier											
Rough-legged Hawk										1	1
Gyrfalcon											
Willow Ptarmigan											
Ptarmigan sp.											
Sandhill Crane					2	1					3
Whimbrel											
Stilt Sandpiper								2			2
Red-necked Phalarope							81	1			82
Phalarope sp.											
Pectoral Sandpiper											
Shorebird		12		7	26	3	10	13	6	15	92
Parasitic Jaeger											
Jaeger sp.											
Glaucous Gull		1		3	3	9	18	3	10		47
Sabine's Gull								9			9
Arctic Tern				3			4	11	4		22
Short-eared Owl											
Passerine											30
All Species	0	50	9	137	392	320	399	325	131	66	1829
Km Surveyed	0.25	1.0	2.25	6.75	1075	1025	15.5	12.0	10.0	10.0	

[a] Blank denotes no birds seen.

Appendix C7. Birds observed on the outside component of aerial surveys at McKinley Bay on August 1, 1990[a].

Species	Transect Number						Total on all transects
	1	2	3	4	5	6	
Pacific Loon	1		1	1			3
Red-throated Loon			2		7	1	10
Common Loon							
Loon sp.			3				3
Tundra Swan							
Brant				110			110
Greater White-fronted Goose							
Dark Goose				80			80
Mallard							
Northern Pintail							
American Wigeon							
Dabbling Duck							
Scaup sp.							
King Eider							
Common Eider							
Eider sp.							
Oldsquaw				5			5
White-winged Scoter							
Surf Scoter				2			2
Scoter sp.				10			10
Red-breasted Merganser							
Diving Duck							
Unidentified Duck				2			2
Northern Harrier							
Rough-legged Hawk							
Gyrfalcon							
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane							
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope							
Phalarope sp.							
Pectoral Sandpiper							
Shorebird							
Parasitic Jaeger							
Jaeger sp.							
Glaucous Gull	1	34	1				36
Sabine's Gull							
Arctic Tern							
Short-eared Owl							
Passerine							
All Species	2	34	7	210	7	1	261
Km Surveyed	9.25	5.0	1.5	1.75	0.5	1.75	261

[a] Blank denotes no birds seen.

Appendix C8. Birds observed on the outside component of aerial surveys at McKinley Bay on August 4, 1990[a].

Species	Transect Number						Total on all transects
	1	2	3	4	5	6	
Pacific Loon		1					1
Red-throated Loon	1						1
Common Loon							
Loon sp.							
Tundra Swan							
Brant	35						35
Greater White-fronted Goose							
Dark Goose							
Mallard							
Northern Pintail							
American Wigeon							
Dabbling Duck							
Scaup sp.							
King Eider							
Common Eider							
Eider sp.							
Oldsquaw				2			2
White-winged Scoter	8						8
Surf Scoter	7	3					10
Scoter sp.				1			1
Red-breasted Merganser							
Diving Duck							
Unidentified Duck							
Northern Harrier							
Rough-legged Hawk							
Gyrfalcon							
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane							
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope							
Phalarope sp.							
Pectoral Sandpiper							
Shorebird							
Parasitic Jaeger							
Jaeger sp.							
Glaucous Gull		1	1	1			3
Sabine's Gull							
Arctic Tern							
Short-eared Owl							
Passerine							
All Species	51	5	1	4	0	0	61
Km Surveyed	9.25	5.0	1.5	1.75	0.5	1.75	261

[a] Blank denotes no birds seen.

Appendix C9. Birds observed on the outside component of aerial surveys at McKinley Bay on August 5, 1990[a].

Species	Transect Number						Total on all transects
	1	2	3	4	5	6	
Pacific Loon							
Red-throated Loon			3				3
Common Loon							
Loon sp.							
Tundra Swan							
Brant						1	1
Greater White-fronted Goose							
Dark Goose							
Mallard							
Northern Pintail					1	2	3
American Wigeon							
Dabbling Duck							
Scaup sp.							
King Eider	275						275
Common Eider							
Eider sp.				5			5
Oldsquaw				10			10
White-winged Scoter							
Surf Scoter							
Scoter sp.	13						13
Red-breasted Merganser							
Diving Duck		1					1
Unidentified Duck				5			5
Northern Harrier							
Rough-legged Hawk							
Gyrfalcon							
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane							
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope							
Phalarope sp.							
Pectoral Sandpiper							
Shorebird				11		1	12
Parasitic Jaeger							
Jaeger sp.							
Glaucous Gull	3	3	1			1	8
Sabine's Gull				10			10
Arctic Tern				5			5
Short-eared Owl							
Passerine							
All Species	291	4	4	46	1	5	351
Km Surveyed	9.25	5.0	1.5	1.75	0.5	1.75	261

[a] Blank denotes no birds seen.

APPENDIX D. BIRDS OBSERVED ON AERIAL SURVEYS AT HUTCHISON BAY IN AUGUST, 1990.

Appendix D1. Birds observed on the bay component of aerial surveys at Hutchison Bay on August 1, 1990[a].

Species	Transect Number 1	2	3	4	5	Total on all transects
Pacific Loon						
Red-throated Loon	5	2	5	2		14
Common Loon						
Loon sp.						
Tundra Swan						
Brant					25	25
Greater White-fronted Goose					19	19
Dark Goose					5	5
Mallard						
Northern Pintail				12		12
American Wigeon						
Dabbling Duck						
Scaup sp.		35	3	8	60	106
King Eider						
Common Eider						
Eider sp.		5				5
Oldsquaw	34	434	433	276	5	1182
White-winged Scoter	3	75		1	1	80
Surf Scoter		229	29	281	85	624
Scoter sp.	5	157	52	21	30	265
Red-breasted Merganser		50	85	5		140
Diving Duck			11	1		12
Unidentified Duck	2		76	55		133
Northern Harrier						
Rough-legged Hawk						
Gyrfalcon						
Willow Ptarmigan						
Ptarmigan sp.						
Sandhill Crane						
Whimbrel						
Stilt Sandpiper						
Red-necked Phalarope						
Phalarope sp.						
Pectoral Sandpiper						
Shorebird		15				15
Parasitic Jaeger						
Jaeger sp.						
Glaucous Gull	4	2	26	9	5	46
Sabine's Gull						
Arctic Tern	3				1	4
Short-eared Owl						
Passerine						
All Species	56	1004	720	671	236	2687
Km Surveyed	10.5	13.5	15.5	6.5	3.5	

[a] Blank denotes no birds seen.

Appendix D2. Birds observed on the bay component of aerial surveys at Hutchison Bay on August 2, 1990[a].

Species	Transect Number 1	2	3	4	5	Total on all transects
Pacific Loon		2	4			6
Red-throated Loon	4	4	4	2	3	17
Common Loon					1	1
Loon sp.						
Tundra Swan						
Brant				25		25
Greater White-fronted Goose						
Dark Goose						
Mallard						
Northern Pintail				12		12
American Wigeon						
Dabbling Duck						
Scaup sp.		30			49	79
King Eider						
Common Eider						
Eider sp.						
Oldsquaw	63	242	285	136	79	805
White-winged Scoter	7	151	2	10		170
Surf Scoter	27	365	289	40	52	773
Scoter sp.	2	144	15	38		199
Red-breasted Merganser			40	31		71
Diving Duck						
Unidentified Duck	30	28	54	70		182
Northern Harrier						
Rough-legged Hawk						
Gyrfalcon						
Willow Ptarmigan						
Ptarmigan sp.						
Sandhill Crane						
Whimbrel						
Stilt Sandpiper						
Red-necked Phalarope						
Phalarope sp.						
Pectoral Sandpiper						
Shorebird						
Parasitic Jaeger						
Jaeger sp.						
Glaucous Gull	12	4	27	8	2	53
Sabine's Gull						
Arctic Tern						
Short-eared Owl						
Passerine						
All Species	145	970	720	372	186	2393
Km Surveyed	10.5	13.5	15.5	6.5	3.5	

[a] Blank denotes no birds seen.

Appendix D3. Birds observed on the bay component of aerial surveys at Hutchison Bay on August 5, 1990[a].

Species	Transect Number					Total on all transects
	1	2	3	4	5	
Pacific Loon			1	2		3
Red-throated Loon	5	3	10	1	7	26
Common Loon						
Loon sp.		1				1
Tundra Swan			1			1
Brant			4	35	25	64
Greater White-fronted Goose						
Dark Goose		4				4
Mallard						
Northern Pintail	11		2	12		25
American Wigeon				1		1
Dabbling Duck			3			3
Scaup sp.	2	75	29	109	37	252
King Eider						
Common Eider						
Eider sp.						
Oldsquaw	266	242	1463	371	94	2436
White-winged Scoter		33	6	6	10	55
Surf Scoter	36	852	95		22	1005
Scoter sp.	113	244	158	74	45	634
Red-breasted Merganser		25	36	70		131
Diving Duck	77	102	81	270	21	551
Unidentified Duck			15			15
Northern Harrier						
Rough-legged Hawk						
Gyrfalcon						
Willow Ptarmigan						
Ptarmigan sp.						
Sandhill Crane						
Whimbrel						
Stilt Sandpiper						
Red-necked Phalarope						
Phalarope sp.						
Pectoral Sandpiper						
Shorebird						
Parasitic Jaeger						
Jaeger sp.	1					1
Glaucous Gull	5	3	1	4	4	17
Sabine's Gull				2		2
Arctic Tern						
Short-eared Owl						
Passerine						
All Species	516	1584	1905	957	265	5227
Km Surveyed	10.5	13.5	15.5	6.5	3.5	

[a] Blank denotes no birds seen.

Appendix D4. Birds observed on the terrestrial component of aerial surveys at Hutchison Bay on August 1, 1990[a].

Species	Transect Number						Total on all transects
	2	3	4	5	6	7	
Pacific Loon			3		4	6	13
Red-throated Loon		2		7	3	7	19
Common Loon							
Loon sp.							
Tundra Swan		2	3	5	58	17	85
Brant							
Greater White-fronted Goose				20	45		65
Dark Goose							
Mallard							
Northern Pintail			19	24	35	7	85
American Wigeon							
Dabbling Duck							
Scaup sp.			30		9		39
King Eider							
Common Eider							
Eider sp.							
Oldsquaw	4				83		87
White-winged Scoter							
Surf Scoter							
Scoter sp.							
Red-breasted Merganser				3	3		6
Diving Duck							
Unidentified Duck	5	10			27	7	49
Northern Harrier						1	1
Rough-legged Hawk							
Gyrfalcon							
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane			2		7	2	11
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope							
Phalarope sp.						6	6
Pectoral Sandpiper							
Shorebird	1			5	10	1	17
Parasitic Jaeger				1		1	2
Jaeger sp.							
Glaucous Gull	6	1	3	13		10	33
Sabine's Gull							
Arctic Tern	6			1	2	10	19
Short-eared Owl						1	1
Passerine							
All Species	22	15	60	79	286	76	538
Km Surveyed	1.75	2.5	11.5	7.5	11.0	11.0	

[a] Blank denotes no birds seen.

Appendix D5. Birds observed on the terrestrial component of aerial surveys at Hutchison Bay on August 2, 1990a.

Species	Transect Number 2	3	4	5	6	7	Total on all transects
Pacific Loon			1	1	2	12	16
Red-throated Loon	1		2	2	7	4	16
Common Loon							
Loon sp.							
Tundra Swan			2	9	33	22	66
Brant							
Greater White-fronted Goose				13	22	25	60
Dark Goose					11		11
Mallard							
Northern Pintail	2		70	49	14		135
American Wigeon							
Dabbling Duck							
Scaup sp.					12		12
King Eider							
Common Eider							
Eider sp.							
Oldsquaw	2		4		58		64
White-winged Scoter							
Surf Scoter							
Scoter sp.							
Red-breasted Merganser							
Diving Duck							
Unidentified Duck			38	5			43
Northern Harrier					1		1
Rough-legged Hawk							
Gyrfalcon		1					1
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane					7	2	9
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope						3	3
Phalarope sp.							
Pectoral Sandpiper						1	1
Shorebird				31	21	2	54
Parasitic Jaeger							
Jaeger sp.							
Glaucous Gull	4		1	14	2	12	33
Sabine's Gull							
Arctic Tern	1					11	12
Short-eared Owl							
Passerine							
All Species	10	1	118	124	190	94	537
Km Surveyed	1.75	2.5	11.5	7.5	11.0	11.0	

[a] Blank denotes no birds seen.

Appendix D6. Birds observed on the terrestrial component of aerial surveys at Hutchison Bay on August 5, 1990[a].

Species	Transect Number						Total on all transects
	2	3	4	5	6	7	
Pacific Loon				6		6	12
Red-throated Loon	7			6	2	7	22
Common Loon							
Loon sp.				2	1	4	7
Tundra Swan			8	9	67	15	99
Brant		15	2			8	25
Greater White-fronted Goose				22		4	26
Dark Goose	25				4		29
Mallard					1		1
Northern Pintail	2	7	52	34	65	25	185
American Wigeon					15		15
Dabbling Duck	1		56	15	6	3	81
Scaup sp.			180	8	14		202
King Eider							
Common Eider							
Eider sp.							
Oldsquaw	11		5		1		17
White-winged Scoter							
Surf Scoter							
Scoter sp.			3				3
Red-breasted Merganser						7	7
Diving Duck		1	76		1		78
Unidentified Duck		205	2	10	64	44	325
Northern Harrier							
Rough-legged Hawk							
Gyrfalcon							
Willow Ptarmigan							
Ptarmigan sp.							
Sandhill Crane				1	2	1	4
Whimbrel							
Stilt Sandpiper							
Red-necked Phalarope					7		7
Phalarope sp.							
Pectoral Sandpiper							
Shorebird	37		9	23	3		72
Parasitic Jaeger							
Jaeger sp.							
Glaucous Gull	7		2	12	5	11	37
Sabine's Gull							
Arctic Tern	1						1
Short-eared Owl							
Passerine							
All Species	91	228	395	148	258	135	1255
Km Surveyed	1.75	2.5	11.5	7.5	11.0	11.0	

[a] Blank denotes no birds seen.

Appendix D7. Birds observed on the outside component of aerial surveys at Hutchison Bay on August 1, 1990[a].

Species	Transect Number 1	2	Total on all transects
Pacific Loon			
Red-throated Loon	1		1
Common Loon			
Loon sp.			
Tundra Swan			
Brant			
Greater White-fronted Goose			
Dark Goose			
Mallard			
Northern Pintail			
American Wigeon			
Dabbling Duck			
Scaup sp.			
King Eider			
Common Eider			
Eider sp.			
Oldsquaw		13	13
White-winged Scoter			
Surf Scoter		2	2
Scoter sp.	8		8
Red-breasted Merganser			
Diving Duck			
Unidentified Duck			
Northern Harrier			
Rough-legged Hawk			
Gyrfalcon			
Willow Ptarmigan			
Ptarmigan sp.			
Sandhill Crane			
Whimbrel			
Stilt Sandpiper			
Red-necked Phalarope			
Phalarope sp.			
Pectoral Sandpiper			
Shorebird			
Parasitic Jaeger			
Jaeger sp.			
Glaucous Gull	1		1
Sabine's Gull			
Arctic Tern			
Short-eared Owl			
Passerine			
All Species	10	15	25
Km Surveyed	11.0	5.25	

[a] Blank denotes no birds seen.

Appendix D8. **Birds observed on the outside component of aerial surveys at Hutchison Bay on August 2, 1990[a].**

Species	Transect Number 1	Transect Number 2	Total on all transects
Pacific Loon			
Red-throated Loon	2		2
Common Loon			
Loon sp.			
Tundra Swan			
Brant			
Greater White-fronted Goose			
Dark Goose			
Mallard			
Northern Pintail			
American Wigeon			
Dabbling Duck			
Scaup sp.			
King Eider			
Common Eider			
Eider sp.			
Oldsquaw			
White-winged Scoter			
Surf Scoter	18		18
Scoter sp.	1		1
Red-breasted Merganser			
Diving Duck			
Unidentified Duck		9	9
Northern Harrier			
Rough-legged Hawk			
Gyrfalcon			
Willow Ptarmigan			
Ptarmigan sp.			
Sandhill Crane			
Whimbrel			
Stilt Sandpiper			
Red-necked Phalarope			
Phalarope sp.			
Pectoral Sandpiper			
Shorebird			
Parasitic Jaeger			
Jaeger sp.			
Glaucous Gull	12		12
Sabine's Gull			
Arctic Tern			
Short-eared Owl			
Passerine			
All Species	33	9	42
Km Surveyed	11.0	5.25	

[a] Blank denotes no birds seen.

Appendix D9. Birds observed on the outside component of aerial surveys at Hutchison Bay on August 5, 1990[a].

Species	Transect Number 1	Transect Number 2	Total on all transects
Pacific Loon		1	1
Red-throated Loon			
Common Loon			
Loon sp.			
Tundra Swan			
Brant			
Greater White-fronted Goose			
Dark Goose			
Mallard			
Northern Pintail			
American Wigeon			
Dabbling Duck			
Scaup sp.			
King Eider			
Common Eider			
Eider sp.			
Oldsquaw	8	24	32
White-winged Scoter	5	4	9
Surf Scoter	6	2	8
Scoter sp.			
Red-breasted Merganser			
Diving Duck	1		1
Unidentified Duck			
Northern Harrier			
Rough-legged Hawk			
Gyrfalcon			
Willow Ptarmigan			
Ptarmigan sp.			
Sandhill Crane			
Whimbrel			
Stilt Sandpiper			
Red-necked Phalarope			
Phalarope sp.			
Pectoral Sandpiper			
Shorebird			
Parasitic Jaeger			
Jaeger sp.			
Glaucous Gull	2	3	5
Sabine's Gull			
Arctic Tern			
Short-eared Owl			
Passerine			
All Species	22	34	56
Km Surveyed	11.0	5.25	

[a] Blank denotes no birds seen.